

Exercises and Problems for Section 1.1

Exercises

- The population of a city, P , in millions, is a function of t , the number of years since 1970, so $P = f(t)$. Explain the meaning of the statement $f(35) = 12$ in terms of the population of this city.
- The pollutant PCB (polychlorinated biphenyl) affects the thickness of pelican eggs. Thinking of the thickness, T , of the eggs, in mm, as a function of the concentration, P , of PCBs in ppm (parts per million), we have $T = f(P)$. Explain the meaning of $f(200)$ in terms of thickness of pelican eggs and concentration of PCBs.
- Describe what Figure 1.8 tells you about an assembly line whose productivity is represented as a function of the number of workers on the line.

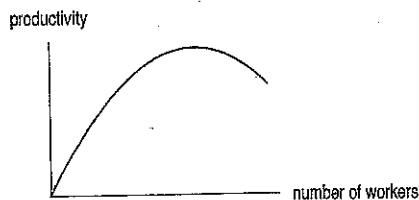


Figure 1.8

For Exercises 4–7, find an equation for the line that passes through the given points.

- $(0, 0)$ and $(1, 1)$
- $(0, 2)$ and $(2, 3)$
- $(-2, 1)$ and $(2, 3)$
- $(-1, 0)$ and $(2, 6)$

For Exercises 8–11, determine the slope and the y -intercept of the line whose equation is given.

- $2y + 5x - 8 = 0$
- $7y + 12x - 2 = 0$
- $-4y + 2x + 8 = 0$
- $12x = 6y + 4$

- Match the graphs in Figure 1.9 with the following equations. (Note that the x and y scales may be unequal.)

- $y = x - 5$
- $-3x + 4 = y$
- $5 = y$
- $y = -4x - 5$
- $y = x + 6$
- $y = x/2$

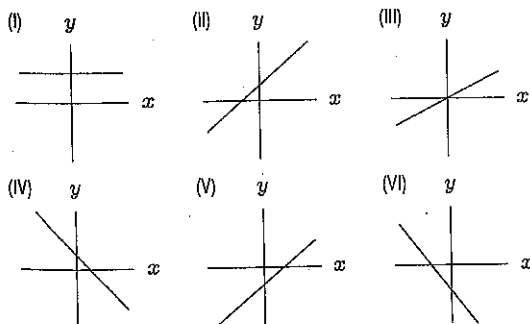


Figure 1.9

- Match the graphs in Figure 1.10 with the following equations. (Note that the x and y scales may be unequal.)

- $y = -2.72x$
- $y = 0.01 + 0.001x$
- $y = 27.9 - 0.1x$
- $y = 0.1x - 27.9$
- $y = -5.7 - 200x$
- $y = x/3.14$

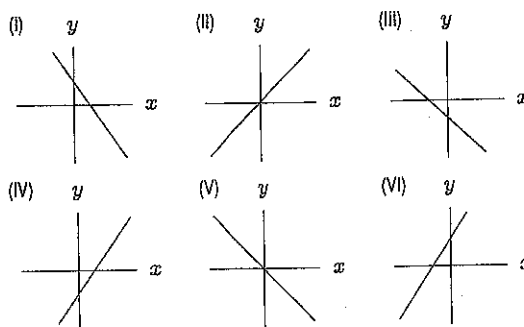


Figure 1.10

- Estimate the slope and the equation of the line in Figure 1.11.

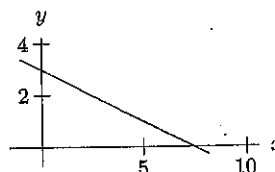


Figure 1.11

- Find an equation for the line with slope m through the point (a, c) .
- Find a linear function that generates the values in Table 1.3.

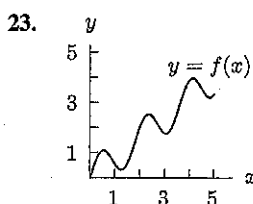
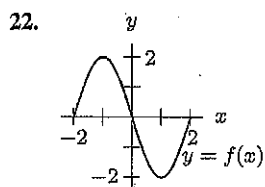
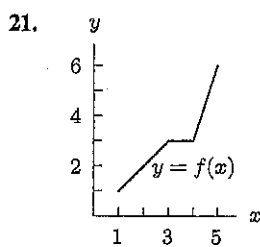
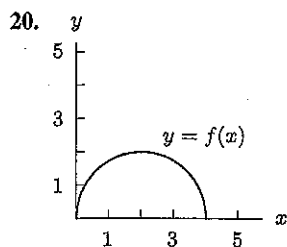
Table 1.3

x	5.2	5.3	5.4	5.5	5.6
y	27.8	29.2	30.6	32.0	33.4

For Exercises 17–19, use the facts that parallel lines have equal slopes and that the slopes of perpendicular lines are negative reciprocals of one another.

- Find an equation for the line through the point $(2, 1)$ which is perpendicular to the line $y = 5x - 3$.
- Find equations for the lines through the point $(1, 5)$ that are parallel to and perpendicular to the line with equation $y + 4x = 7$.
- Find equations for the lines through the point (a, b) that are parallel and perpendicular to the line $y = mx + c$, assuming $m \neq 0$.

For Exercises 20–23, give the approximate domain and range of each function. Assume the entire graph is shown.



Find domain and range in Exercises 24–25.

24. $y = x^2 + 2$

25. $y = \frac{1}{x^2 + 2}$

26. If $f(t) = \sqrt{t^2 - 16}$, find all values of t for which $f(t)$ is a real number. Solve $f(t) = 3$.

In Exercises 27–31, write a formula representing the function.

27. The volume of a sphere is proportional to the cube of its radius, r .

28. The average velocity, v , for a trip over a fixed distance, d , is inversely proportional to the time of travel, t .

29. The strength, S , of a beam is proportional to the square of its thickness, h .

30. The energy, E , expended by a swimming dolphin is proportional to the cube of the speed, v , of the dolphin.

31. The number of animal species, N , of a certain body length, l , is inversely proportional to the square of l .

Problems

In Problems 32–35 the function $S = f(t)$ gives the average annual sea level, S , in meters, in Aberdeen, Scotland,¹ as a function of t , the number of years before 2008. Write a mathematical expression that represents the given statement.

32. In 1983 the average annual sea level in Aberdeen was 7.019 meters.

33. The average annual sea level in Aberdeen in 2008.

34. The average annual sea level in Aberdeen was the same in 1865 and 1911.

35. The average annual sea level in Aberdeen increased by 1 millimeter from 2007 to 2008.

36. In December 2010, the snowfall in Minneapolis was unusually high,² leading to the collapse of the roof of the Metrodome. Figure 1.12 gives the snowfall, S , in Minneapolis for December 6–15, 2010.

- How do you know that the snowfall data represents a function of date?
- Estimate the snowfall on December 12.
- On which day was the snowfall more than 10 inches?
- During which consecutive two-day interval was the increase in snowfall largest?

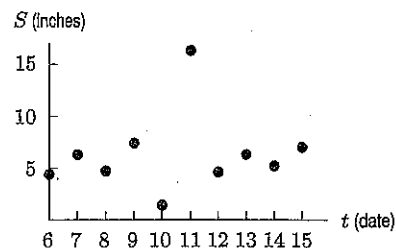


Figure 1.12

37. The value of a car, $V = f(a)$, in thousands of dollars, is a function of the age of the car, a , in years.

- Interpret the statement $f(5) = 6$.
- Sketch a possible graph of V against a . Is f an increasing or decreasing function? Explain.
- Explain the significance of the horizontal and vertical intercepts in terms of the value of the car.

38. Which graph in Figure 1.13 best matches each of the following stories?³ Write a story for the remaining graph.

- I had just left home when I realized I had forgotten my books, and so I went back to pick them up.
- Things went fine until I had a flat tire.
- I started out calmly but sped up when I realized I was going to be late.

¹www.decc.gov.uk, accessed June 2011

²http://www.crh.noaa.gov/mpx/Climate/DisplayRecords.php

³Adapted from Jan Terwel, "Real Math in Cooperative Groups in Secondary Education." *Cooperative Learning in Mathematics*, ed. Neal Davidson, p. 234 (Reading: Addison Wesley, 1990).